Arlington County Canopy Study

A Presentation to Arlington's Communities

Sponsored by Arlington County Civic Federation

Green Infrastructure Center

Presented by Karen Firehock, Executive Director and Christian Schluter, GIS Landscape Planner

Workshop facilitated by the nonprofit Green Infrastructure Center (GIC). Founded in 2006, we help communities evaluate green assets and manage them to maximize ecological, economic and cultural values.

We do this by:

Building landscape models and landcover maps

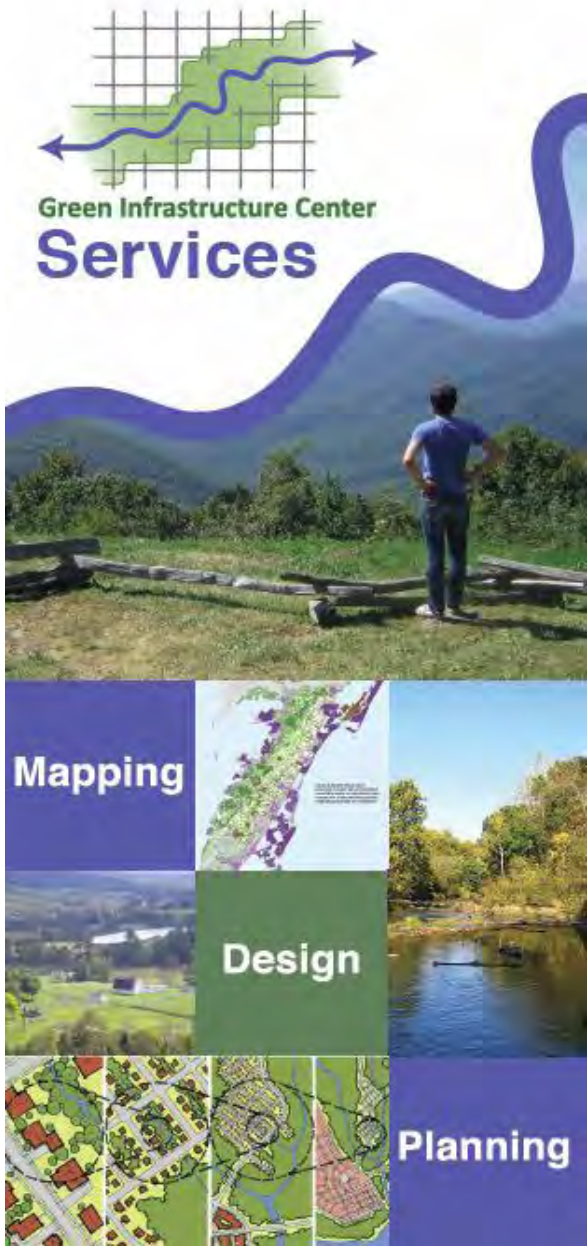
Teaching courses and workshops

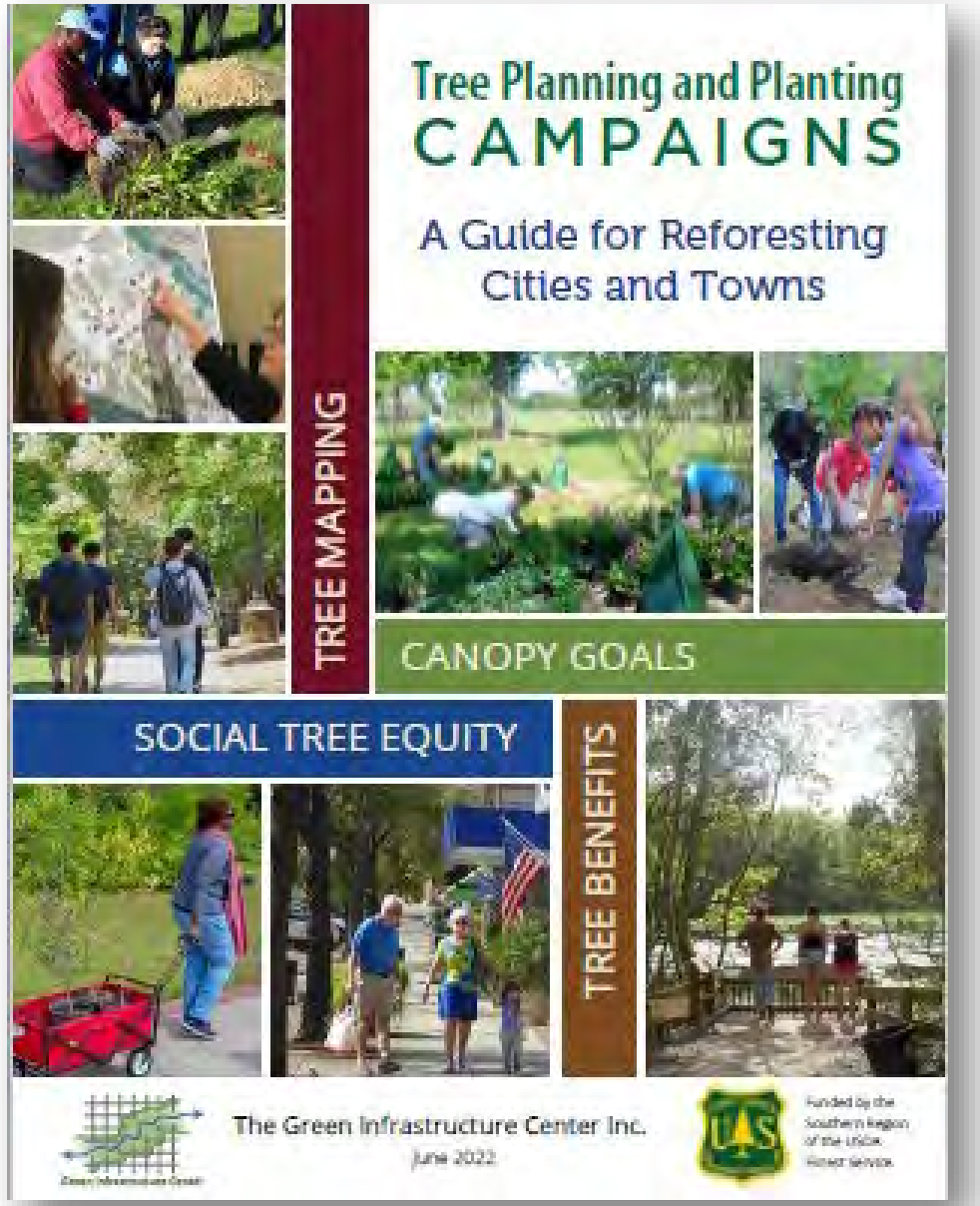
Researching new green infrastructure methods

Helping communities create strategies

GIC staff specialize and are certified in GIS, Planning, Urban Forestry, Tree Risk Assessment and Landscape Architecture

www.gicinc.org





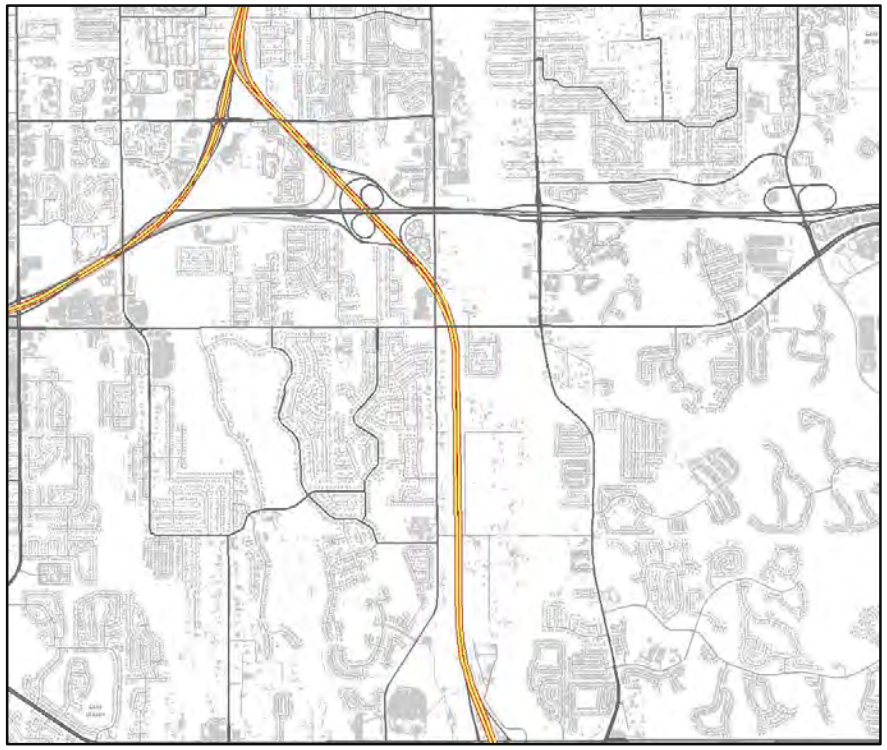
Our tree campaign guide is based on 15 years of testing and has all the arguments and methods for citizens and policy makers to break through; ***moving from wishes to direct action***.

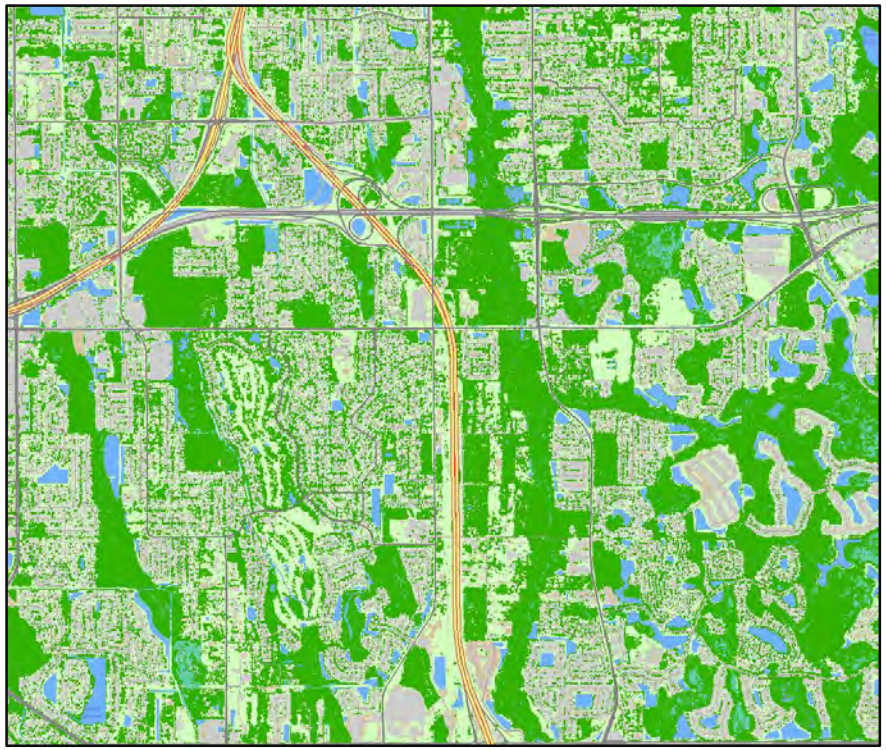
This guide features our work throughout the southern United States and other tree advocacy groups too --- highlighting the best methods, tools and tips from community-based urban forestry groups.

It also tackles pressing issues such as mapping urban heat islands, working in diverse communities and using the right data to make the case for urban forests. And it's free to download!

http://www.gicinc.org/PDFs/TreePlantingCampaignGuide_GIC_June2022.pdf

Urban Forests are Green Infrastructure!





Left shows the gray infrastructure including buildings and roads (left). Classified high-resolution satellite imagery (right) adds a green infrastructure data layer (trees and other vegetation).

Trees: the original green infrastructure!

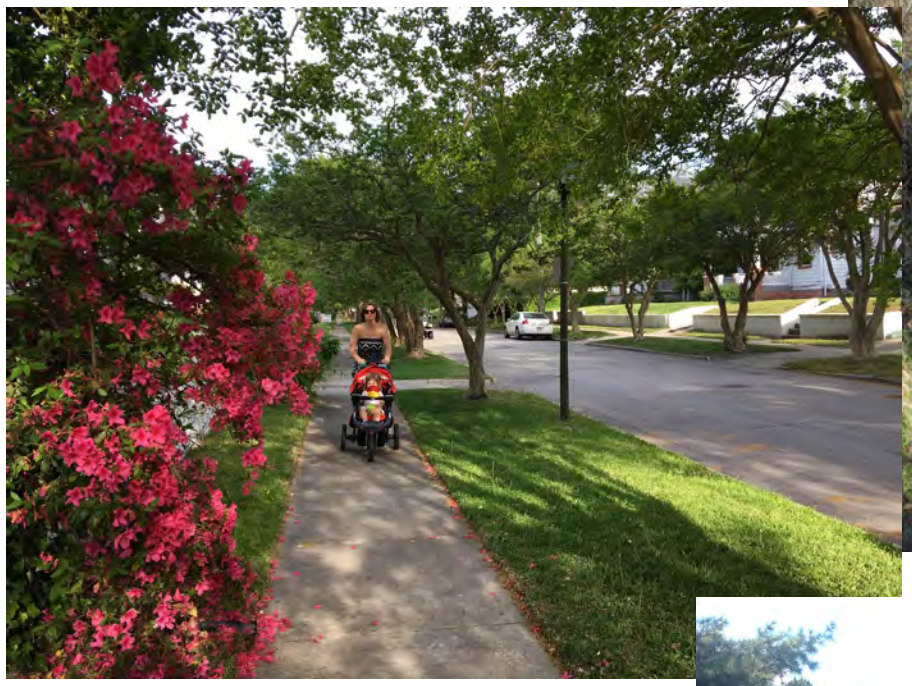
Trees give us cleaner air, shade, beauty and stormwater benefits at a cost that is far cheaper than engineered systems!

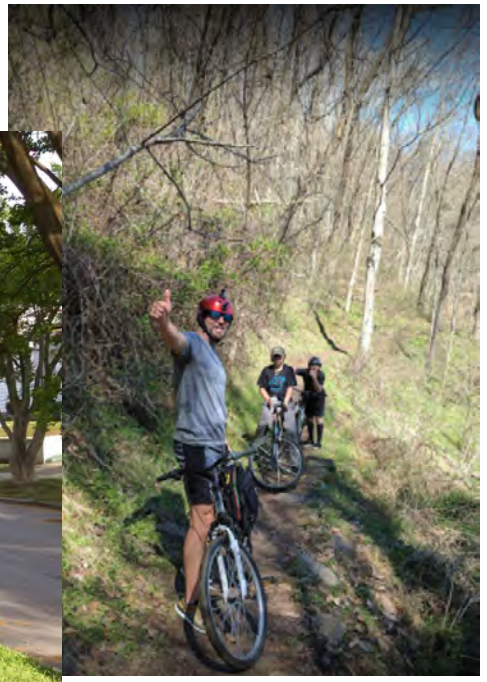
Estimates for the amount of water a typical street tree can intercept in its crown, range from 760 gallons to 4000 gallons per tree per year, depending on species.

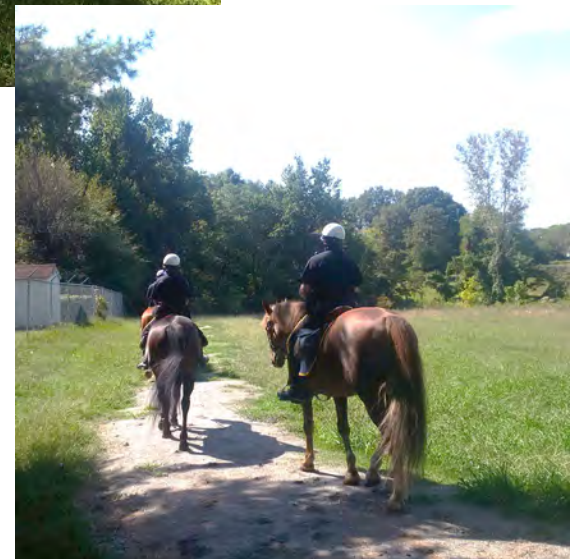
Estimate the value of a tree in your yard with itreemytree
https://mytree.itreetools.org/#/

Trees: Create Healthy Communities

- Access to fitness opportunities. (addresses obesity, nature deficit disorders)
- Clean air – trees absorb pollutants, VOCs, filter runoff, cool the city. (combat asthma)
- Well-being and mental health - -people heal faster when they can see or access green. (hospitals need this for patients, reduces absenteeism of workers)
- Less crime occurs near trees. (issue especially for downtowns and public housing areas)
- Employees will exercise if they can access green where they work and on the way to work. (addresses employee health)

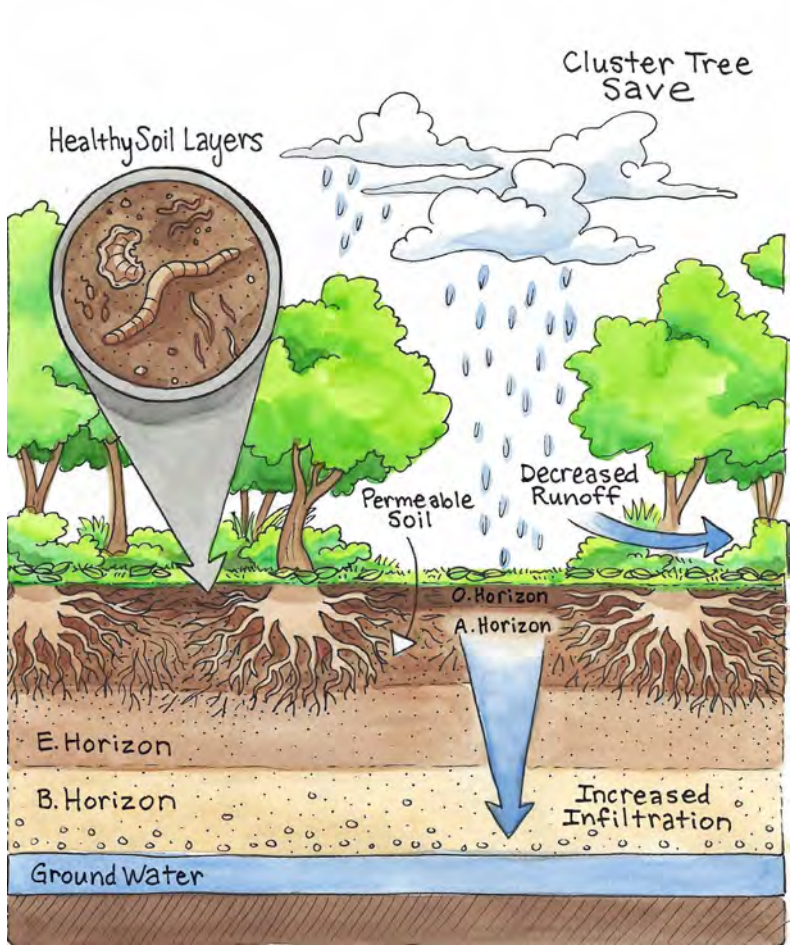






What does a tree need for health?

- Air (circulation)
- Light (photosynthesis)
- Water (growth)
- Nutrients (from soil and even the air)
- Space (roots and canopy need to spread out)
- Free from pests and diseases (watch out for these and treat as needed)

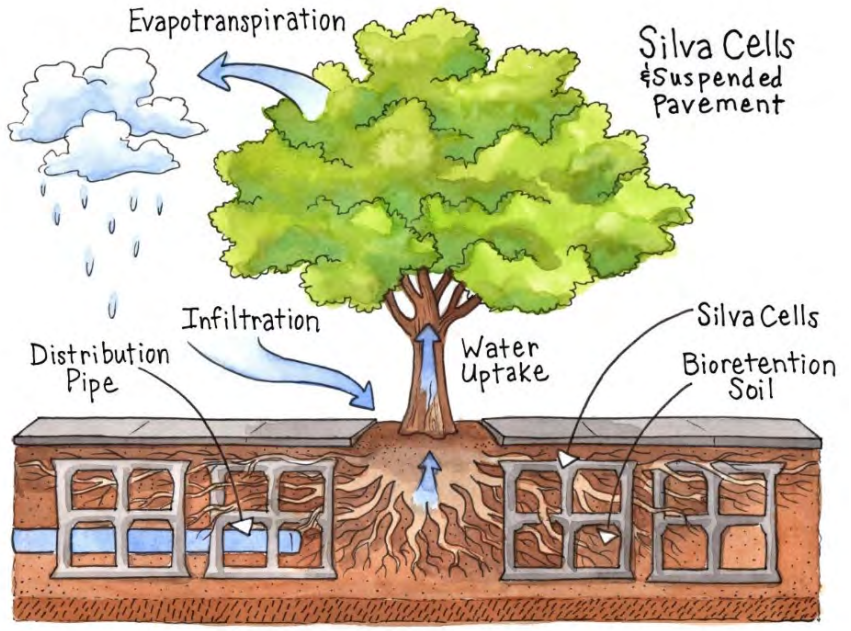


Urban trees also need watering the first few years to help them get established.

They should have some attention to pruning to ensure proper and safe form, to avoid issues like this one below.

Check out Trees VA for more! https://treesvirginia.org/education/tree-planting

Accommodate Large Trees



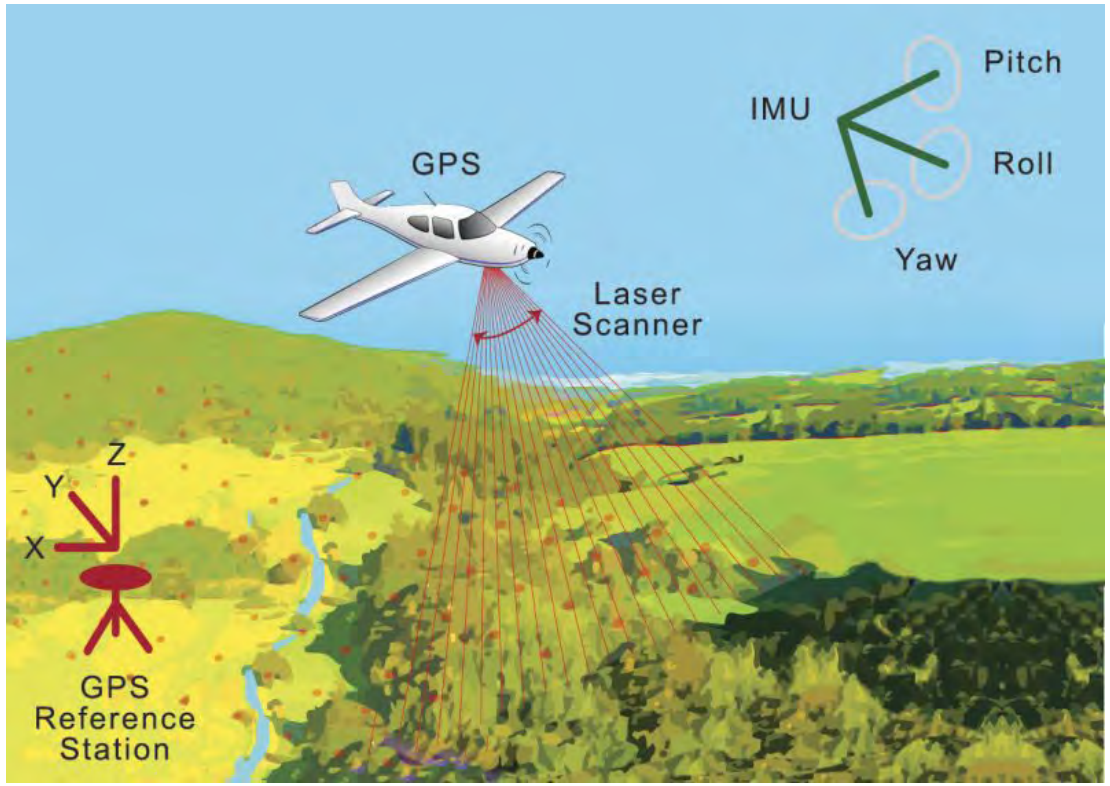
Larger trees offer greater benefits – so think carefully when setting planting goals for streets! We can also treat the roots and alter existing pavement to help this tree continue to thrive.

Consider using suspended pavement systems, rather than just choosing small trees! Trees will pay back your investment!

Use Imagery to Determine Canopy Cover

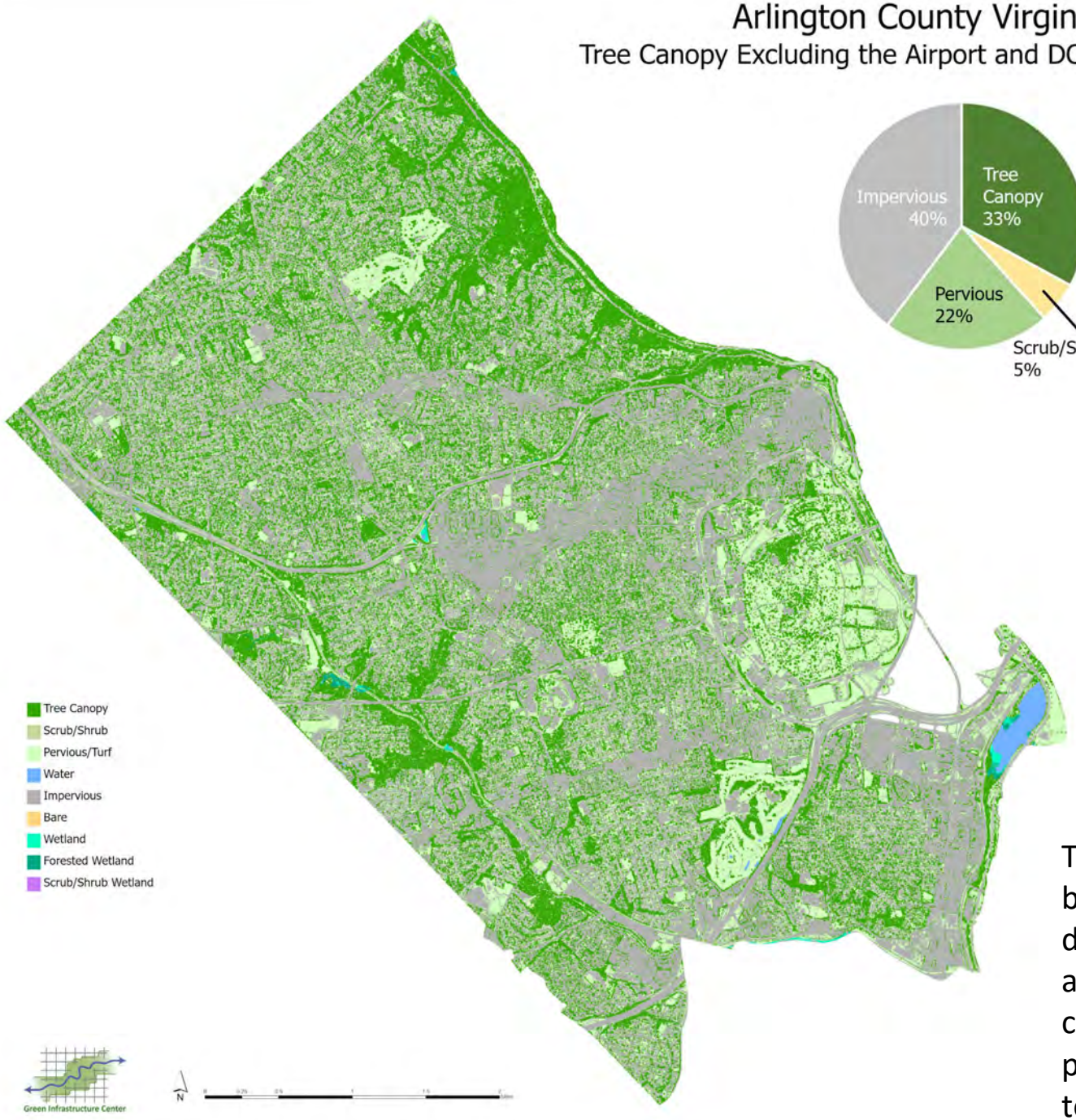
We use National Agricultural Imagery Program (NAIP) infrared bands that we classify to turn images into data = land cover map. The program collects new data every two years. The latest imagery was flown in 2021. Each image is a little different by year depending on the angle and time of day the flight took place. We also use LiDAR to determine the heights of vegetation.

We used LiDAR to distinguish trees from bushes



We believe that the most recent prior canopy study did not use LiDAR as part of their analysis, giving them errors – mistaking bushes for trees.

- Light detection and ranging (LiDAR) is a remote sensing technology using laser scans to create detailed 3D models of objects. We use it to determine vegetation height and shape.
- A plane with a lidar unit flies back and forth sending laser pulses down in a narrow swath to get data for a large area. Each pulse reflects off the ground or an object above the ground (called a “return”). Measuring the time it takes for the laser pulse to return to a sensor, combined with the sensor’s position, we can determine the 3D coordinates of each point from which the laser pulse is reflected.
- The combination of all spatially resolved returns constitutes a point cloud, or the lidar data product. A common product derived from point clouds are tree canopy models. We can separate bushes (short objects) from trees (tall objects over 10 feet tall).



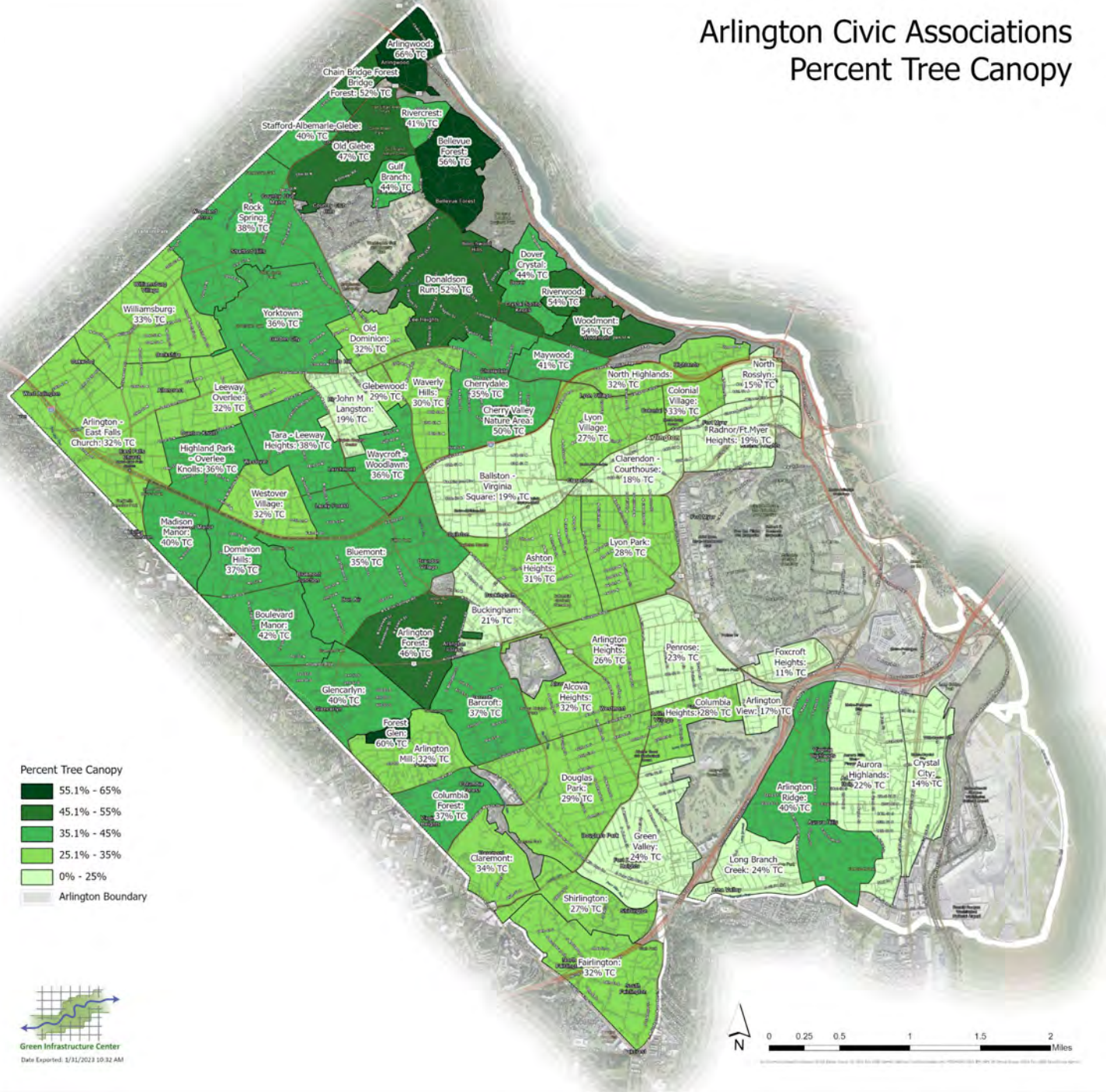
This tree in Fairlington was beheaded from storm damage. Many older trees are suffering and need care. We also need to plant new young trees today for the future.

Excluding land in the airport and land on Dept of Defense properties, **Arlington's Tree Canopy is 33%** based on imagery flown in 2021 (data processedfall 2022).

The prior 2017 study showed 41% canopy (more than we found.)

All studies have a margin of error of several percentage points. But this **difference of 8%** is greater than a such a margin.

Arlington Civic Associations
Percent Tree Canopy



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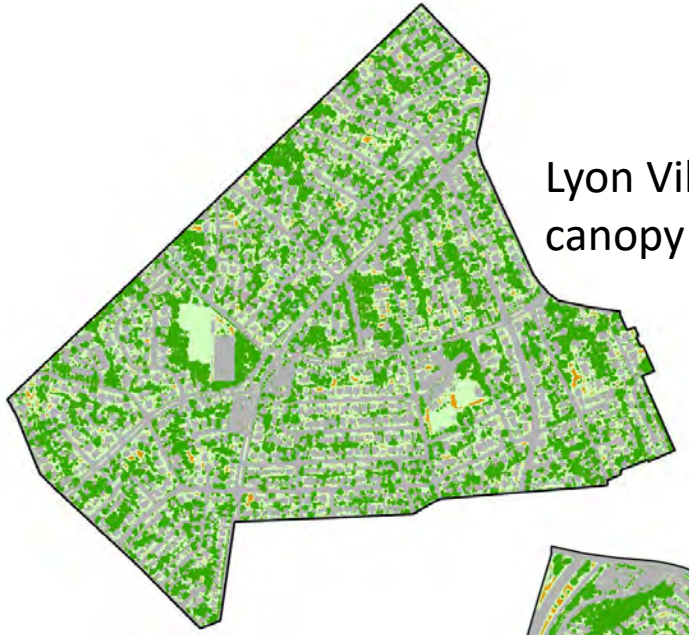
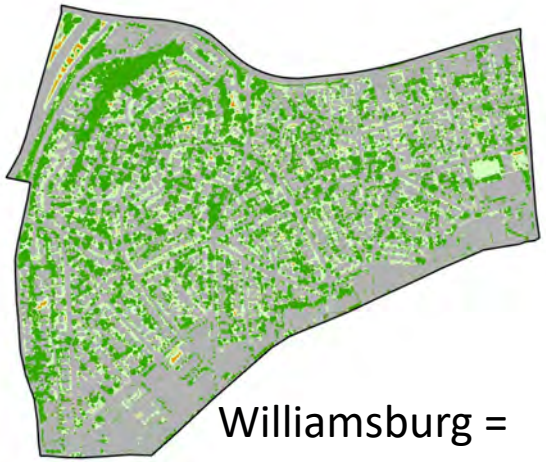


Lyon Village = 27% canopy cover



Williamsburg = 33% canopy cover

Green Valley = 25% canopy

Air Quality Benefits Provided by Trees

Pollutant (Abbrev.)	Description for Removed Pollutants	Removal rate (lbs/acres/year)	Acres Canopy	Total (Pounds)
CO	Carbon monoxide removed annually	**0.145064**	5181	751.58
NO2	Nitrogen dioxide removed annually	**2.640850**	5181	13,682.24
O3	Ozone removed annually	**15.363324**	5181	79,597.38
PM10	Particulate matter greater than 2.5 microns and less than 10 microns removed annually	**4.086180**	5181	21,170.50
PM2.5	Particulate matter less than 2.5 microns removed annually	**0.490699**	5181	2,542.31
SO2	Sulfur dioxide removed annually	**0.945710**	5181	4,899.72
Element				
C	Carbon stored in existing trees	N/A	5181	633,546,840
C	Carbon stored annually	4.43	5181	22,951.83

Trees clean the air and reduce greenhouse gas causing chemicals. Even at the neighborhood scale, trees significantly reduce particulate pollutants resulting in less respiratory illnesses, such as asthma.

* based on iTree multipliers and USFS calculations for carbon rates for Northern Va.

What is an urban heat island?

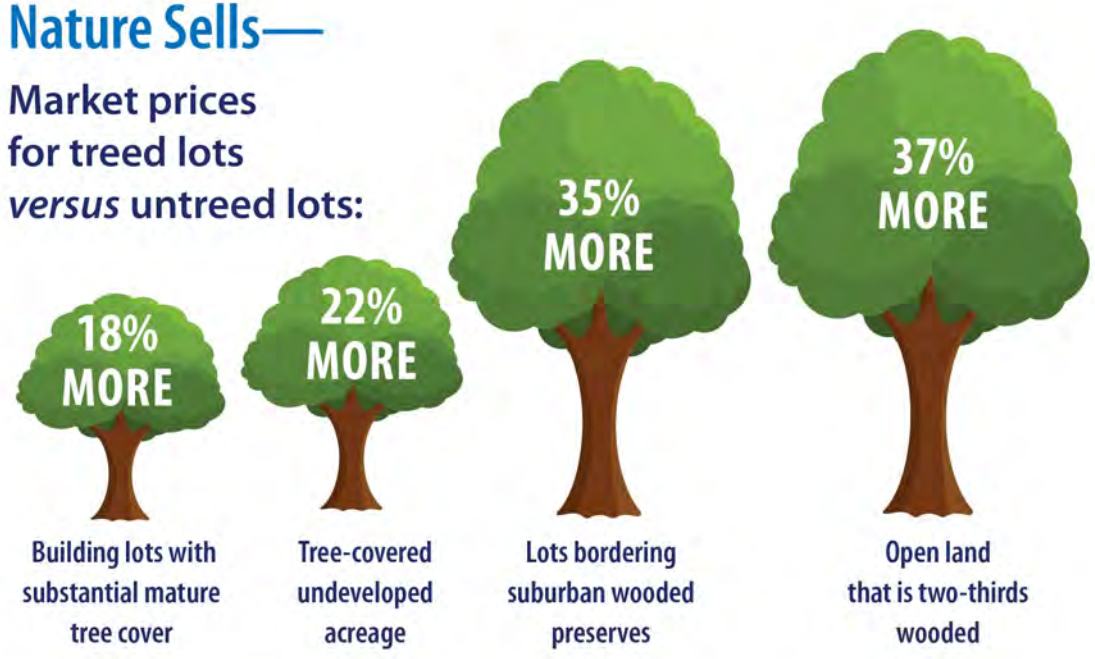
Urban heat islands occur when a metro area is significantly warmer than its surrounding rural areas due to human activities. Temperature differences are usually larger at night than during the day, and is most apparent when winds are weak.

Paved areas in cities absorb and re-radiate tremendous heat!

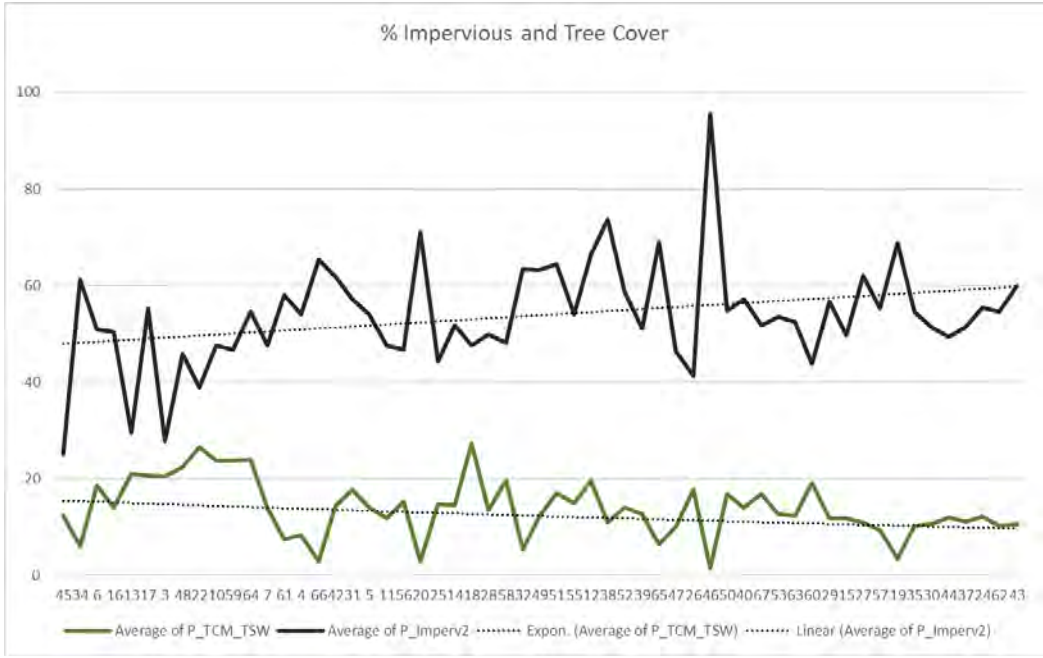
Greenhouse gases trap that heat and re-radiate it back to Earth.

Trees combat heat & add value to neighborhoods

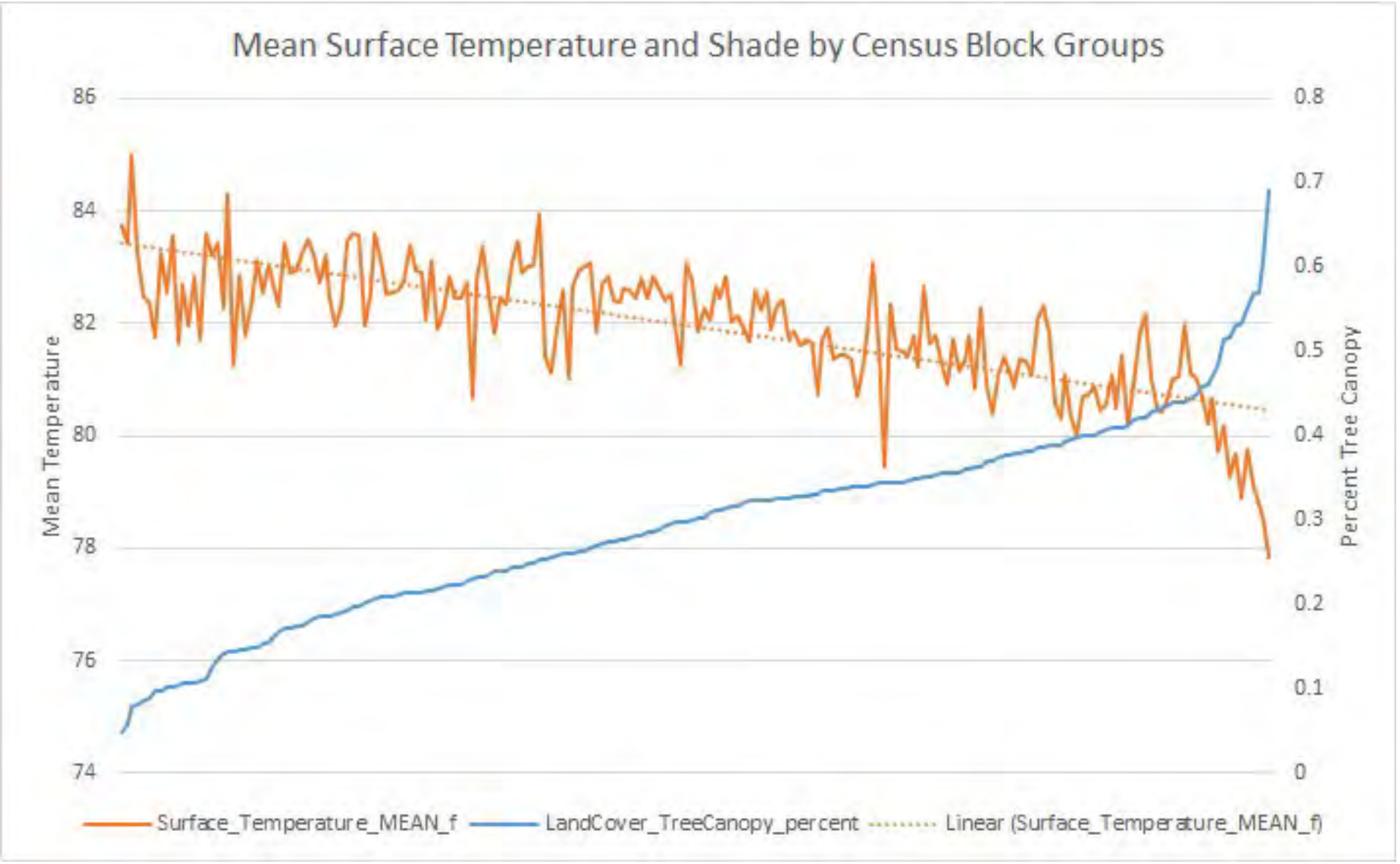
Trees add value to properties, in improved real estate values, savings on air conditioning costs, lower heat island and even sequestering carbon!



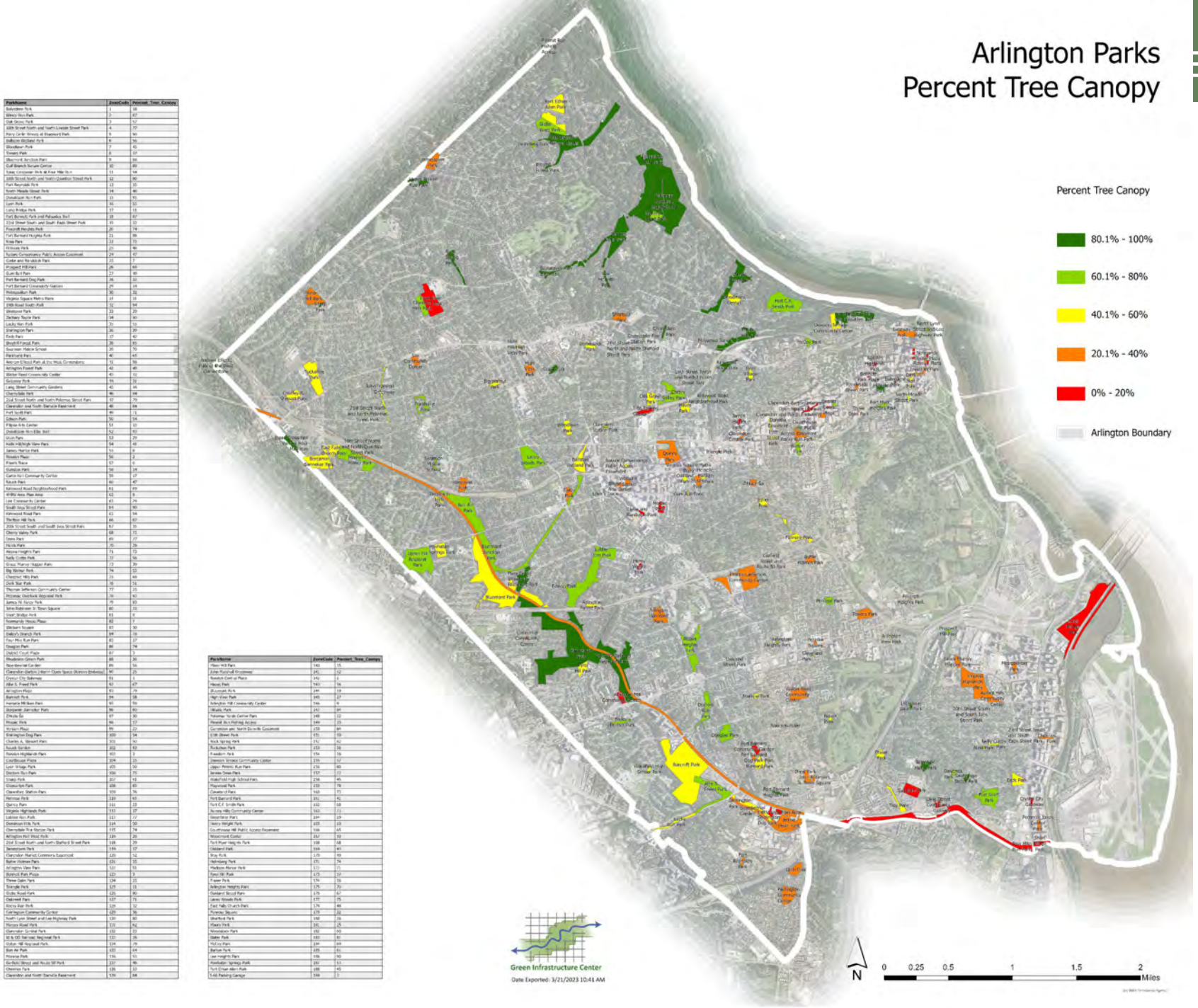
Source: Kathleen Wolf, 2007, *City Trees and Property Values.*



Decreases in tree canopy correlate to increased urban heating. Areas under trees are often 12 degrees cooler and neighborhoods are cooler too!



Areas in Arlington lacking good tree cover are significantly hotter.



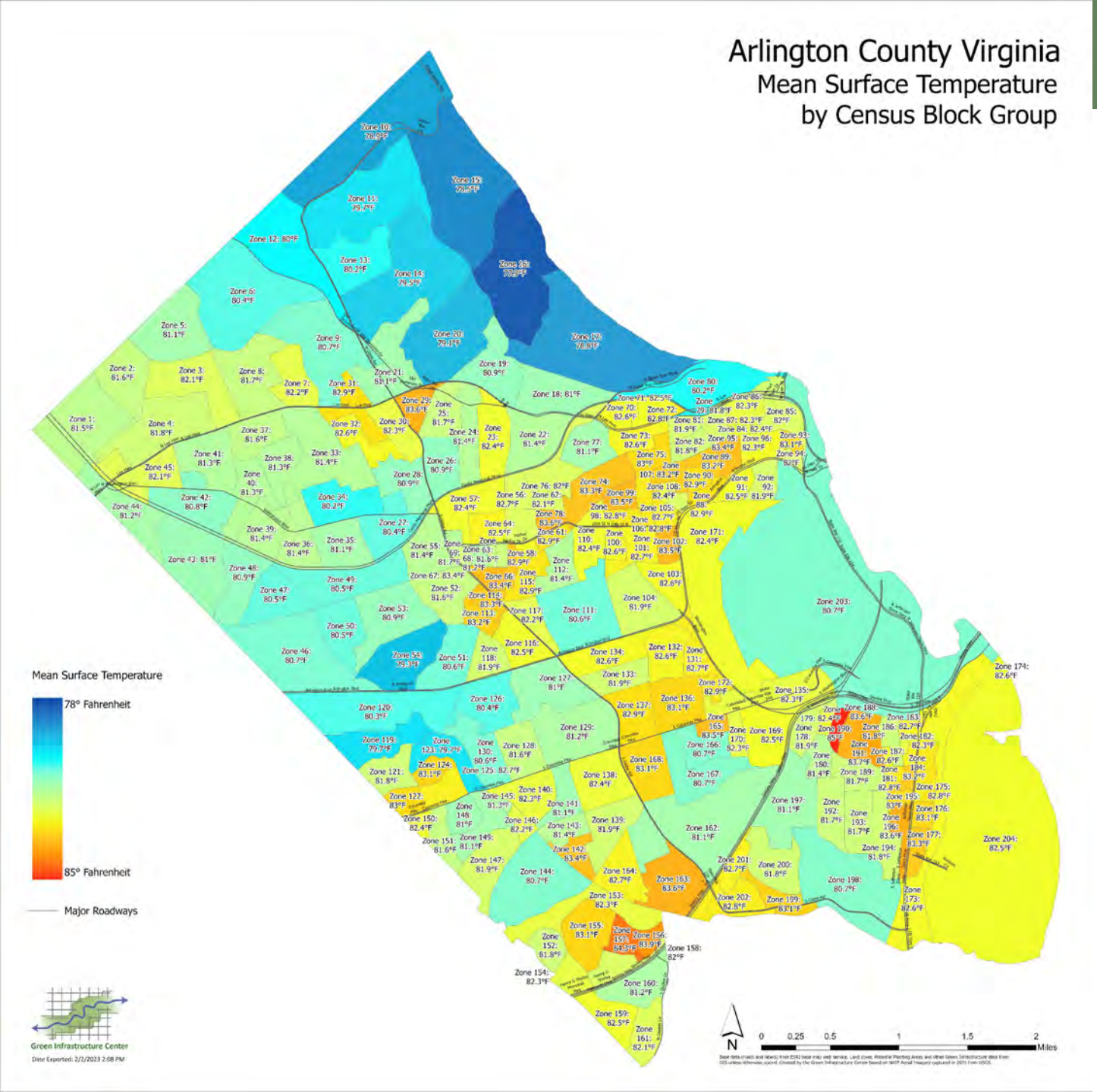
Trees shading parks

Red areas have 20% or less shade. Some parks with abundant playing fields will have less trees.

Trees shading streets

Red and orange streets have less than 5% shade.

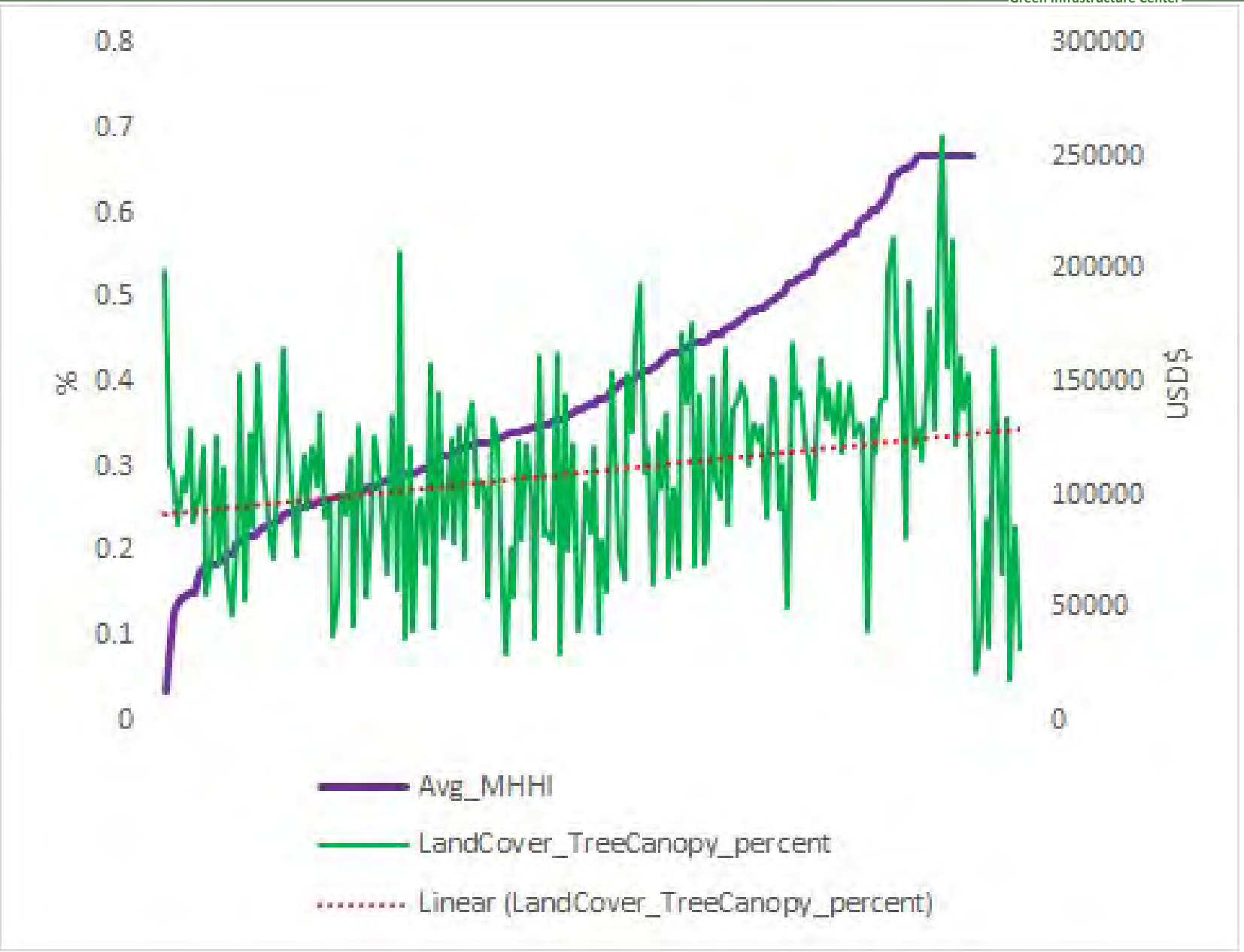
Example from Ballston. Shade is important for commercial areas too (people shop longer and pay more in shaded commercial areas).



Census Blocks & Tree Cover

Areas with little or no trees are significantly hotter. Blues are cooler areas while oranges and reds are hotter.

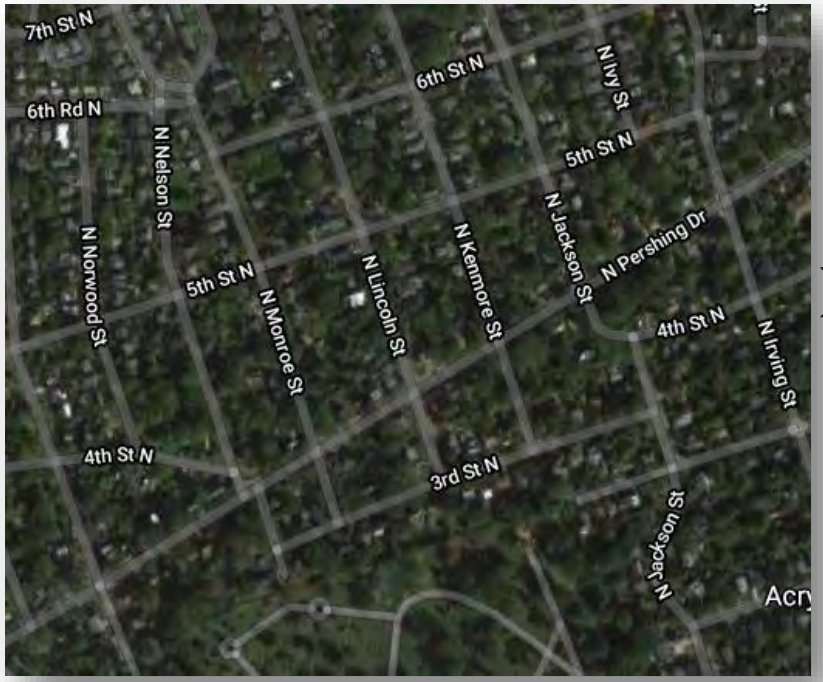
Electricity demand for air conditioning increases approximately 1–9% for each 2°F increase in temperature. (U.S. EPA).



Tree Canopy trends slightly higher in higher income neighborhoods in Arlington.

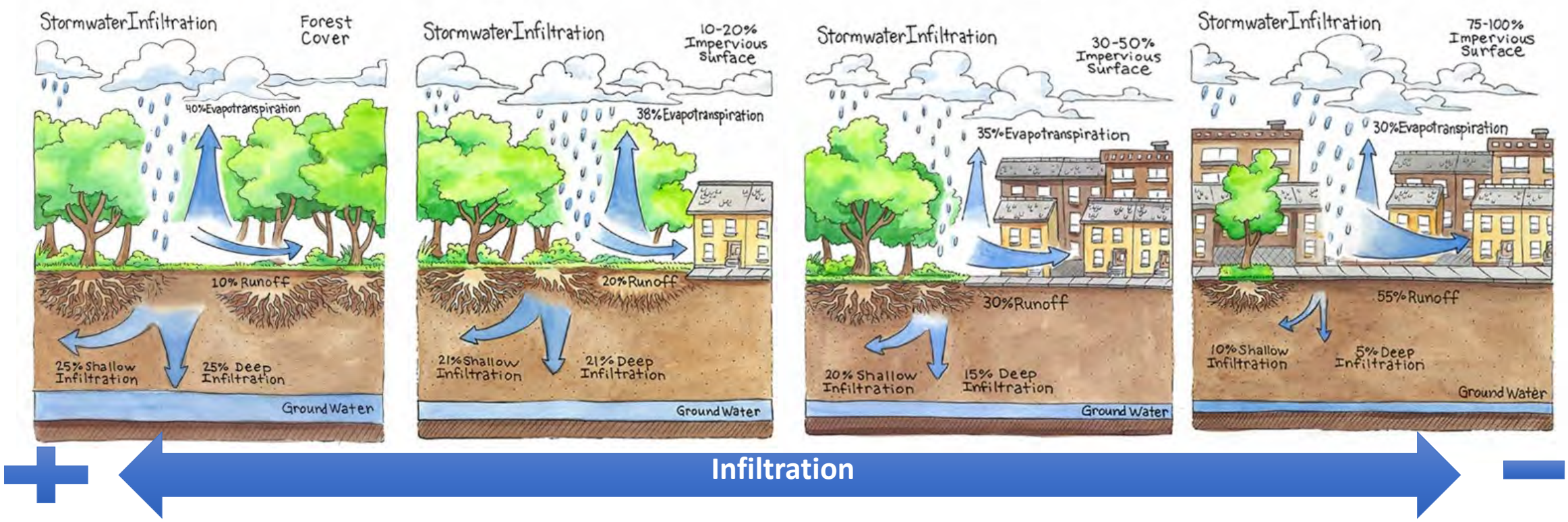
Trees Moderate Stormwater Runoff

How do we make this…



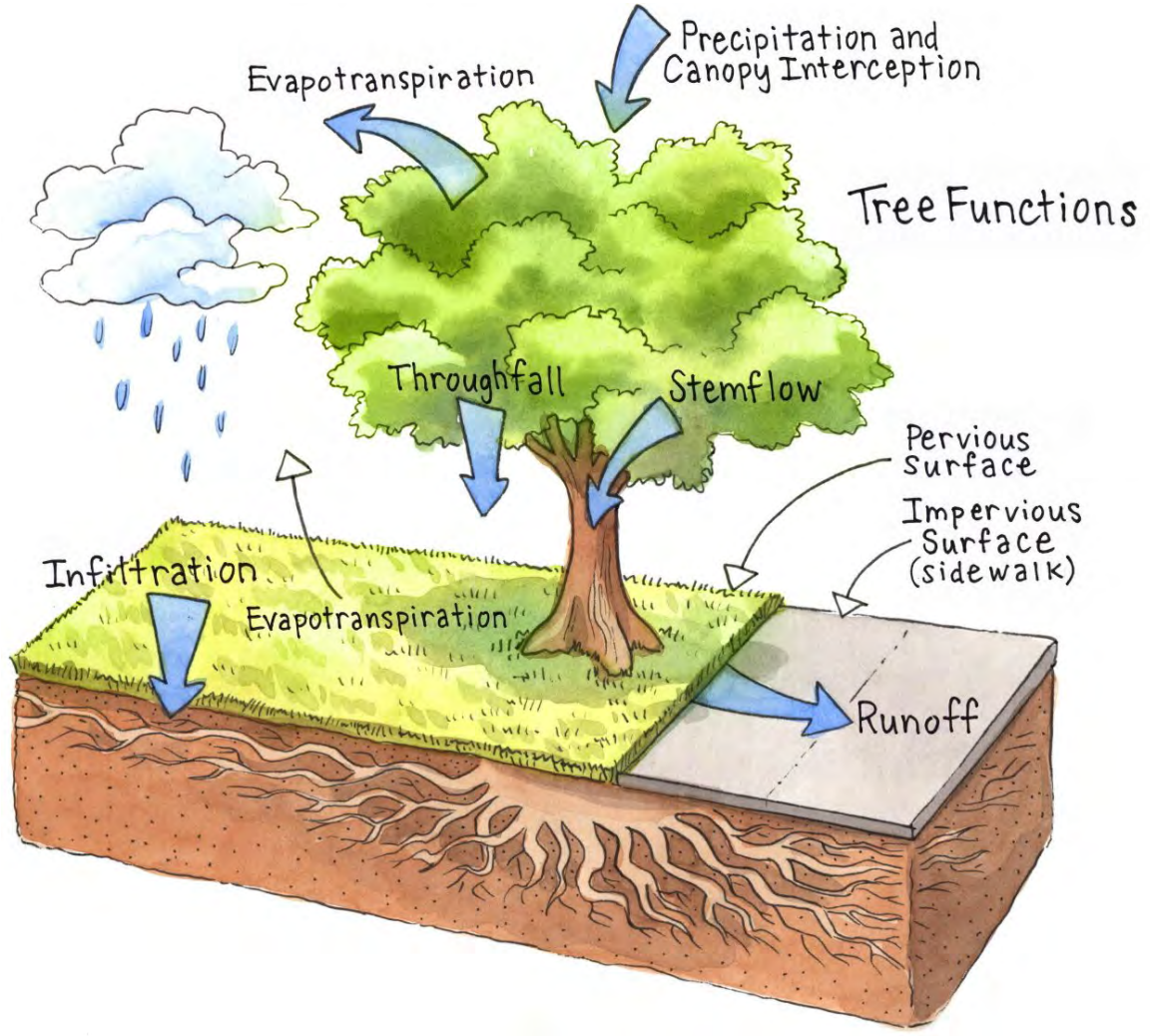
function like this?

As land cover changes, so does stormwater runoff and infiltration ...



Urban Tree Canopy and Water

- 20%+ of annual rainfall retained in crown (Xiao et al., 2000)
- Delays runoff up to 3.7 hours
- ↑ infiltration capacity of soils
- One tree can soak up 700 to 4000 gallons water annually depending on the age and species!



This parking lot could be retrofitted so we get less of this …

One acre of pavement releases 36 times more runoff than a forest.

During a rainfall event of one inch, one acre of forest will release 750 gallons of runoff, while a parking lot will release 27,000 gallons.

(PennState Extension).

Arlington Flooding

Micro-climates

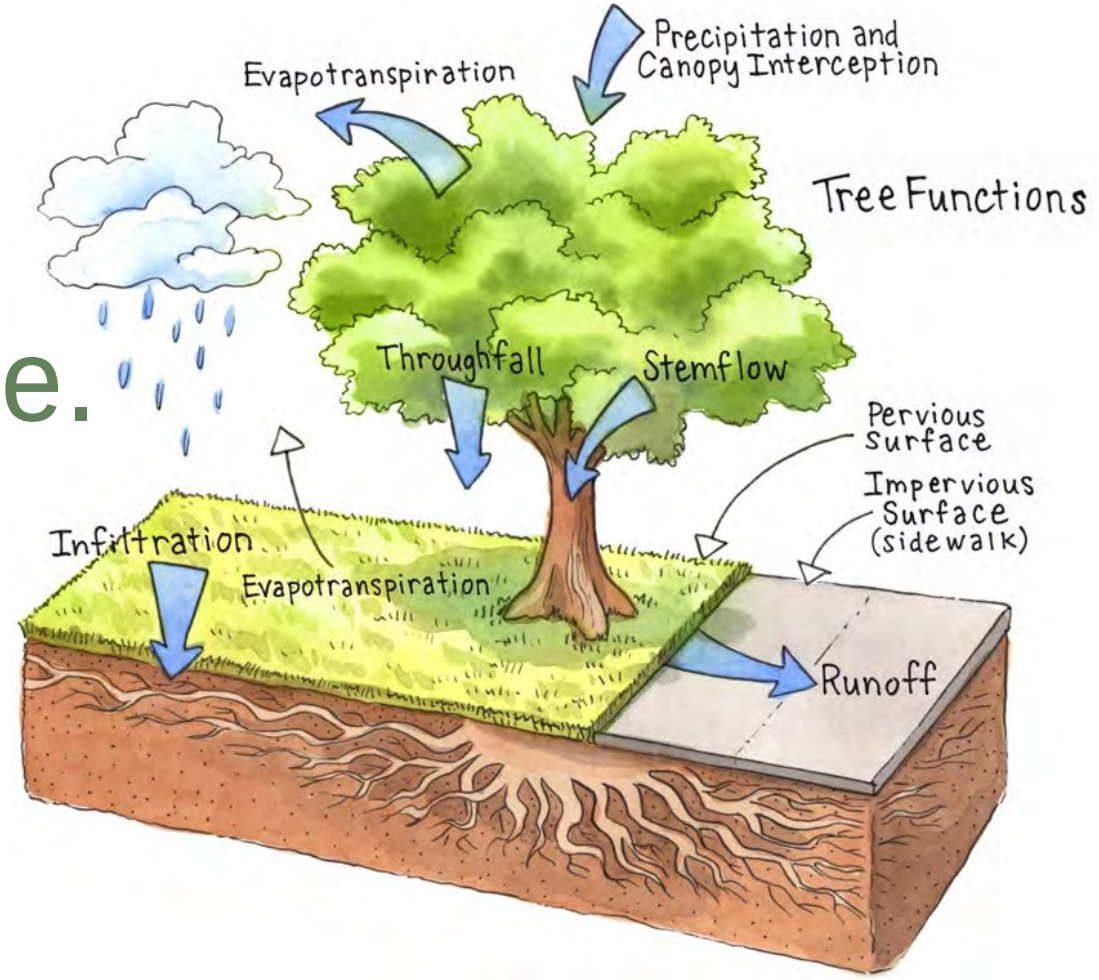
Urban areas change weather patterns .. By increasing heat = more evaporation and more rain = more flooding

Stream in Arlington overtops its banks

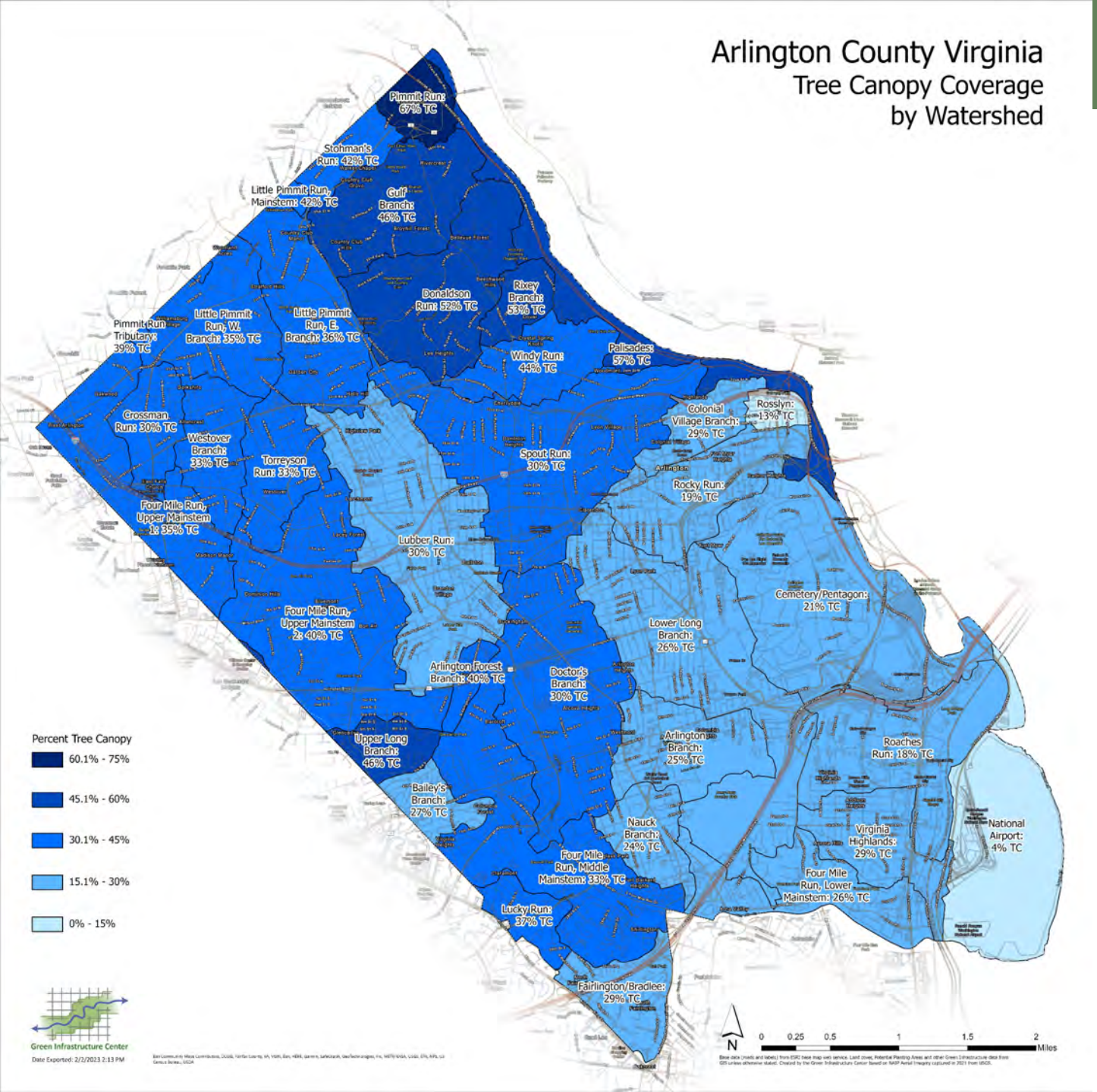
https://www.arlingtonmagazine.com/is-arlington-ready-for-the-next-flood/

Link and use trees as stormwater infrastructure.

- One large tree can soak up thousands of gallons of stormwater annually!
- Establish city trees' role as infrastructure to receive federal aid for post-storm clean up efforts.
- Credit urban trees in a stormwater utility fee to promote more urban tree plantings. Currently the county is proposing a 5% credit to utility fees for tree planting.



We will provide an analysis of how much stormwater the trees soak up in Arlington at the community event in March.



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The better treed each watershed is, the more water can be captured. This map shows canopy cover in each watershed

(darkest blue has highest tree cover).

Note that streams in Arlington may still be impaired by stormwater that flows underground from paved areas and enters streams directly. But having more trees can help capture much of that rainwater before it runs off into storm drains.

The trees and stormwater calculator shows how much stormwater and runoff pollution trees soak up!

During a 10 year/24 storm, Arlington's trees soak up 33.7 million gallons of water = about 5.5 Olympic swimming pools of water!

Name: Arlington, Virginia, USA* — **Urban Tree Canopy Stormwater Model** — **version May 4, 2022**

The Green Infrastructure Urban Tree Canopy Stormwater Model estimates stormwater runoff yields for current and potential land cover. The methodology is based upon the NRCS TR-55 method for small urban watersheds. It is used to provide better estimates using GIC's high-resolution land cover and modeling of potential canopy area.

				million gallons			
	TOTALS	30.8%	40.9%	33.7	-	-	30.8%

		Statistics by Drainage Basin (current settings)						Variable							Variable
	Area	Current Tree Cover	Current Impervious Cover	Tree H20 Capture	Increased H2O w/xx% tree loss	Added H2O Capture w/xx% PCA	Adjusted Tree Cover from loss and gain scenarios	Pick an Event	Pick a loss scenario		Converted Land			Canopy Added	Enter % canopy to add
		%		million gallons			%	Event	% UTC loss	% FOS Loss	% Imperv	Max TC Possible	Maximum Potential Added Canopy Area	% Canopy Added	% of PCA achieved
1	Arlington Branch	24.6%	45.1%	0.7	-	-	24.6%	10 yr / 24	0%	0%	0%	31.0%	6.5%	0.0%	0%
2	Arlington Forest Branch	39.9%	38.3%	0.2	-	-	39.9%	10 yr / 24	0%	0%	0%	48.0%	8.1%	0.0%	0%
3	Bailey's Branch	27.0%	49.6%	0.3	-	-	27.0%	10 yr / 24	0%	0%	0%	36.3%	9.3%	0.0%	0%
4	Cemetery/Pentagon	21.0%	29.9%	1.4	-	-	21.0%	10 yr / 24	0%	0%	0%	26.8%	5.7%	0.0%	0%
5	Colonial Village Branch	28.6%	54.4%	0.4	-	-	28.6%	10 yr / 24	0%	0%	0%	33.7%	5.1%	0.0%	0%
6	Crossman Run	30.4%	43.2%	0.4	-	-	30.4%	10 yr / 24	0%	0%	0%	40.1%	9.7%	0.0%	0%
7	Doctor's Branch	30.5%	40.5%	1.7	-	-	30.5%	10 yr / 24	0%	0%	0%	40.7%	10.2%	0.0%	0%
8	Donaldson Run	51.6%	20.9%	2.7	-	-	51.6%	10 yr / 24	0%	0%	0%	58.0%	6.4%	0.0%	0%
9	Fairlington/Bradlee	29.5%	44.9%	0.5	-	-	29.5%	10 yr / 24	0%	0%	0%	39.5%	10.0%	0.0%	0%
10	Four Mile Run, Lower Mainstem	25.7%	49.0%	0.8	-	-	25.7%	10 yr / 24	0%	0%	0%	35.9%	10.2%	0.0%	0%
11	Four Mile Run, Middle Mainstem	33.3%	42.6%	1.9	-	-	33.3%	10 yr / 24	0%	0%	0%	41.1%	7.8%	0.0%	0%
12	Four Mile Run, Upper Mainstem 1	35.4%	38.4%	1.2	-	-	35.4%	10 yr / 24	0%	0%	0%	44.9%	9.5%	0.0%	0%
13	Four Mile Run, Upper Mainstem 2	40.0%	32.3%	2.7	-	-	40%	10 yr / 24	0%	0%	0%	49.2%	9.2%	0.0%	0%
14	Gulf Branch	45.7%	27.3%	1.6	-	-	46%	10 yr / 24	0%	0%	0%	55.4%	9.7%	0.0%	0%
15	Little Pimmit Run, E. Branch	36.3%	38.0%	1.1	-	-	36%	10 yr / 24	0%	0%	0%	47.0%	10.7%	0.0%	0%
16	Little Pimmit Run, Mainstem	41.7%	29.5%	0.1	-	-	42%	10 yr / 24	0%	0%	0%	52.3%	10.6%	0.0%	0%

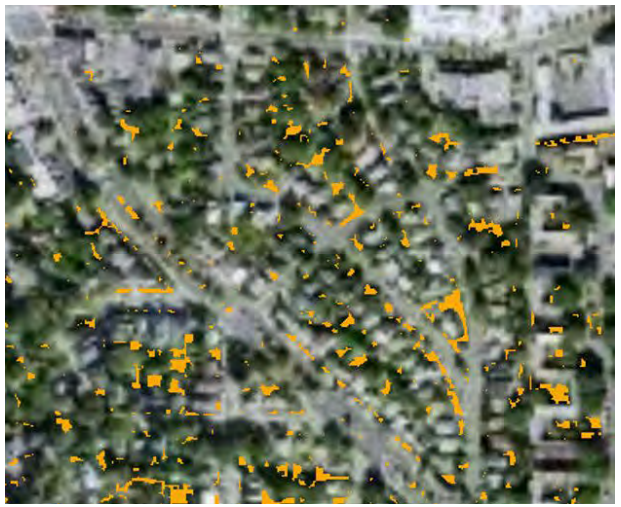
It also shows how much pollution the trees take up and how much more pollution can be absorbed through planting!

It is a tool to run scenarios. For either volume or for pollutants captured and prevented from polluting the water.

In this example we planted 50% of the available open space and we see the increased capture in both % and lbs/yr.

		22338	9	1766	13	2320	17	-3424	-2	-288	-3	-121	-1
	Variable	Statistics by Drainage Basin (current settings)											
Canopy Added	Enter % canopy to add	Non-Point Pollution Captured by Existing Trees (% = percent of total load without trees)						Change in Pollution Load from Landuse Variables (% = percent increase or decrease of total load)					
% Canopy Added	% of PCA achieved	N lbs/yr	N (%)	P lbs/yr	P (%)	SED t/yr	SED (%)	N lbs/yr	N (%)	P lbs/yr	P (%)	SED t/yr	SED (%)
3.2%	50%	401	6	31	10	48	13	-52	-1	-5	-2	-2	0
4.1%	50%	157	13	12	20	14	21	-11	-1	-1	-2	0	-1
4.6%	50%	155	6	12	10	20	13	-32	-1	-3	-2	-1	-1
2.9%	50%	926	5	73	7	113	12	-199	-1	-17	-2	-7	-1
2.6%	50%	188	6	14	9	29	14	-25	-1	-2	-2	2	1
4.9%	50%	222	6	17	10	31	15	-37	-1	-3	-2	-3	-2
5.1%	50%	887	6	68	10	127	16	-212	-2	-18	-3	-8	-1
3.2%	50%	2,285	26	185	34	142	32	-151	-2	-13	-4	-5	-2
5.0%	50%	239	6	18	8	41	16	-68	-2	-6	-3	0	0
5.1%	50%	534	7	42	12	55	12	-119	-2	-10	-3	-5	-1
3.9%	50%	1,358	10	108	15	137	17	-179	-1	-15	-3	-5	-1
4.7%	50%	784	9	62	14	87	18	-125	-2	-10	-3	-7	-2

How can we get more trees growing in Arlington?



Potential planting area data

After mapping the landcover, we examine open spaces that could be available for planting = lawn, or bare earth as PPA.

NAIP Image

Potential Planting Area (PPA)

We can see whether we can fit trees in the open spaces (PPS) and then digitally grow out those trees to determine future canopy (PCA). This helps us know just how many trees could be planted in Arlington.

Potential Planting Spots (PPS)*

Potential Canopy Area (PCA)

So, how many trees could be planted?

Possible Planting Spots

*We tried to exclude all sports fields.

See the map of potential trees by neighborhood.

Arlington Canopy Fast Facts!

714 acres of open space where can plant about **132,660** trees.

Of those trees:

10,030 could be planted in parks and **5,315** at schools*

44,202 as street trees (within 50 feet of a road centerline) and the remainder private property.

What is the Maximum Canopy Cover for Arlington?

Potential Canopy Area (PCA)

Another way to look at this…what will it take to maintain the 33% we do have?

We can't plant all the open spaces (shaded county with no veggie gardens or sunny spots). Usually about half the available open space could be planted. Remember current canopy is 33%.

Total Max Canopy is 39%. We estimate you could plant ½ the PPA so a canopy goal to get from 33% to 39% is 6% more canopy. If we planted ½ of that it would be 36% or about 66,300 trees.

What are trees worth?

The value of tree benefits varies widely, but can be as much as $80 to $120 per tree per year for a large tree. Small trees that never get very large, like the crape myrtle, provide not much more than $15 in benefits on average. In some cases they are a net loss to communities after the costs are subtracted. The Center for Urban Forest Research has studied large, medium, and small trees in a number of locations throughout the West and found that, on average, mature large trees deliver an annual net benefit two to six times greater than mature small trees:

Mature tree size
The approximate tree size 40 years after planting.

Relative Size at Maturity:

Small-stature
Less than 25 feet tall and wide with trunk diameters less than 20 inches.

Medium-stature
25 - 40 feet tall and wide with trunk diameters 20 - 30 inches.

Large-stature
Greater than 40 feet tall and wide with trunk diameters commonly over 30 inches.

Large Tree
- Total benefits/year = $55
- Total costs/year = $18
- Net benefits/year = $37
- Life expectancy = 120 years
- Lifetime benefits = $6,600
- Lifetime costs = $2,160
- Value to community = $4,440

Medium Tree
- Total benefits/year = $33
- Total costs/year = $17
- Net benefits/year = $16
- Life expectancy = 60 years
- Lifetime benefits = $1,980
- Lifetime costs = $1,020
- Value to community = $960

Small Tree
- Total benefits/year = $23
- Total costs/year = $14
- Net benefits/year = $9
- Life expectancy = 30 years
- Lifetime benefits = $690
- Lifetime costs = $420
- Value to community = $270

—hypothetical case using data for trees at year 30, projected to life expectancy from McPherson, E.G., et. al. 2003. Northern mountain and prairie community tree guide: benefits, costs and strategic planting. Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service. 92p.

https://urbanforestrysouth.org/resources/library/citations/the-large-tree-argument-1-up

GREEN INFRASTRUCTURE CENTER INC.

Green Infrastructure Center

Key Strategy: Save existing trees. Bigger is better!

Larger trees provide more benefits. Replacing a 20-inch diameter tree today with a 1-inch diameter tree, could take 20 or more years to achieve the benefits a large tree provides, so keep large trees in place AND plant the next generation today!

https://www.arlingtonva.us/Government/Programs/Sustainability-and-Environment/Ecology/Native-Plants

Image credit: City of Greenville from GIC's campaign with the city

What can **YOU** do?

•Plant trees! There are groups here to help! A tree can be large (6-8 feet tall and 1 inch wide, or a small sapling (they survive better but take a little longer to grow tall).

•Take care of trees on your property. Have a certified arborist advise you on any limbs that could be at risk of falling or a tree that may have enough rot it needs removal.
https://goodtreecare.com/find-an-arborist/va/arlington

•Encourage your church, business, HOA or other institution to plant trees on their properties and care for those they already have (do they need pruning, treatment for pests, mulching or other care).

•Get engaged with the county's urban forest master plan:
https://www.arlingtonva.us/Government/Projects/FNRP/FNRP-Overview-and-Timeline

Local Resources for Arlington

Arlington County Sustainability and Environment Office Forestry information
https://www.arlingtonva.us/Government/Programs/Sustainability-and-Environment/Trees

Arlington's Ecosystem Services Report for its trees:
https://environment.arlingtonva.us/wp-content/uploads/sites/13/2017/02/iTree-2016-Written-report.pdf

Arlington's Urban Forest Master Plan (update in process):
https://www.arlingtonva.us/Government/Projects/FNRP/FNRP-Overview-and-Timeline

Arlington's Urban Forestry and Natural Resources Commission (FNRC) provides the County Board with advice and recommendations:
https://www.arlingtonva.us/Government/Commissions-and-Advisory-Groups/Forestry-and-Natural-Resources-Commission

Apply to plant trees in your Arlington Community! (due in June)
https://www.ecoactionarlington.org/community-programs/trees/

Arlington County Civic Federation Environmental Affairs Committee: https://www.civfed.org/about-us/committees/environmental-affairs/

USDA Urban Forest Connections Webinar Series -
https://www.fs.usda.gov/research/products/multimedia/webinars/urbanforestconnections

Next Steps*

Visit maps to learn how well canopied your neighborhood is and how many trees can be planted!

Provide your comments today (see staff at flip charts), fill out a comment card or send your comments on actions you would like to see taken by your community, by the county, by everyone, or requests for more information to:
accf213comment@gmail.com

We will send this presentation to your email (if you provided it at registration).

We will create a report and share your ideas with the county! You will get a copy by email (from sign-in).

**This workshop is sponsored by the Arlington County Civic Federation in its role to inform citizens. The ACCF and Arlington County have not yet endorsed the information provided here.*

You can download the tree canopy map and the civic association to your computers and zoom in to see your neighborhood. Get maps here:

https://www.dropbox.com/s/aeog8idh29c4m39/Tree_Canopy_and_Potential_Planting_Areas_20230324.pdf?dl=1

https://www.dropbox.com/s/fgutf4469r6gzaq/Arlington_Civic_Associations_20230324.pdf?dl=1

End

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Visit GIC's website to access tools from today!

www.gicinc.org

Extra slides if reference needed

New! Arlington's Tree Canopy is 31% based on imagery that was flown in 2021 and processed by GIC in fall 2022.

The prior 2017 study showed 38% canopy coverage, about 7% more than we found. Why might this be the case?

GIC made sure to use 2018 **LiDAR data** to differentiate trees from shrubs. LiDAR stands for Light Detection and Ranging. It bounces a beam from a source above the land and measures the return interval back to the source. If the beam takes longer to return, then the item is shorter. Previous studies did not employ LiDAR. They may have overestimated tree cover. And trees have likely been lost.